Evaluation of Risk from TPH Fractions in Selected Groundwater Monitoring Well Data for Portland Harbor Sites
May 21, 2015

EPA selected the aliphatic $EC_{>10} – EC_{12}$ fraction for development of a preliminary remediation goal, based on various lines of evidence. It appears that if the same selection criteria are applied to groundwater data from the Gasco MGP facility, additional TPH fractions warrant development of PRGs. Other sources of petroleum hydrocarbons will likely have different TPH fraction compositions, so it is unclear if any one fraction will always represent the greatest risk to aquatic organisms.

DEQ recommends including the following TPH fraction TRVs in the table of Portland Harbor PRGs: **Aliphatics** EC_5-EC_6, $EC_{>6}$-EC_8, $EC_{>8}$-EC_{10},$EC_{>10}$-EC_{12}; **Aromatics** $EC_{>8}$-EC_{10}, $EC_{>10}$-EC_{12},$EC_{>12}$-EC_{16},$EC_{>16}$-EC_{21}, >EC_{21}-EC_{34}. The rationale for adding the additional fractions is described below:

- Based on corrected solubility values, the fractions listed above have water TRVs that are less than 1/10th of their respective solubilities with exception of the aromatic $EC_{>21}$-EC_{34} (the TRV is 1/2 the assumed solubility). This indicates that physically and chemically these fractions of TPH have the potential to be individually present in the dissolved aqueous phase at concentrations equating to a HQ>10.

- Weathering in the environment alters TPH composition causing shifts in the fraction distribution in sediment and pore-water. Over time different fractions and/or constituents may emerge as risk drivers, thus, it is difficult to predict with confidence which TPH fraction will be the risk driver at a site.

- The character of TPH at Portland Harbor sites is highly variable. At sites such as ARCO 22T, Willbridge and GASCO, co-mingling and weathering of gasoline, diesel, other fuels, oils and wastes have produced TPH releases with compositions that encompass the full range of aliphatic and aromatic fractions identified as hazardous substances by the State of Oregon and which are not characteristic of any specific product.

- Data from the GASCO site indicates a composition dominated by a broad spectrum of low to high molecular weight aromatics ($EC_{>8}$ through EC_{34}), and a virtual absence of aliphatic fractions with the exception of $EC_{>6}$-EC_8 (Figure 1). In contrast, at the ARCO 22T Terminal site, the full range of soluble TPH aliphatic and aromatic fractions are present, although on a weight basis the composition is largely dominated by middle range aliphatics and aromatics (Figure 2).

- Hazard quotients for TPH fractions from selected Gasco groundwater monitoring wells are shown in Table 1 and Figure 3, with hazard indices shown in Figure 4. Hazard quotients for TPH fractions from selected Arco groundwater monitoring wells are shown in Figure 5, with hazard indices shown in Figure 6. The figures indicate that, other than the high molecular weight aliphatics, all other TPH fractions have the potential to constitute a significant ecological risk on individually and to make substantial contributions to the cumulative risk. Since the TRVs are all based on the same endpoint, narcosis, the risk is cumulative and thus all fractions present should be

factored into the calculation of risk. Excluding some fractions may significantly underestimate overall risk.

- If TPH fractions are detected in transition zone water at the Gasco and Arco sites consistent with groundwater concentrations shown in Figures 1 to 2, then unacceptable risk would be identified for multiple receptors (including benthic macroinvertebrates, invertivorous and omnivorous fish, amphibians, and aquatic plants), similar to the multiple lines of evidence presented in the Portland Harbor BERA.

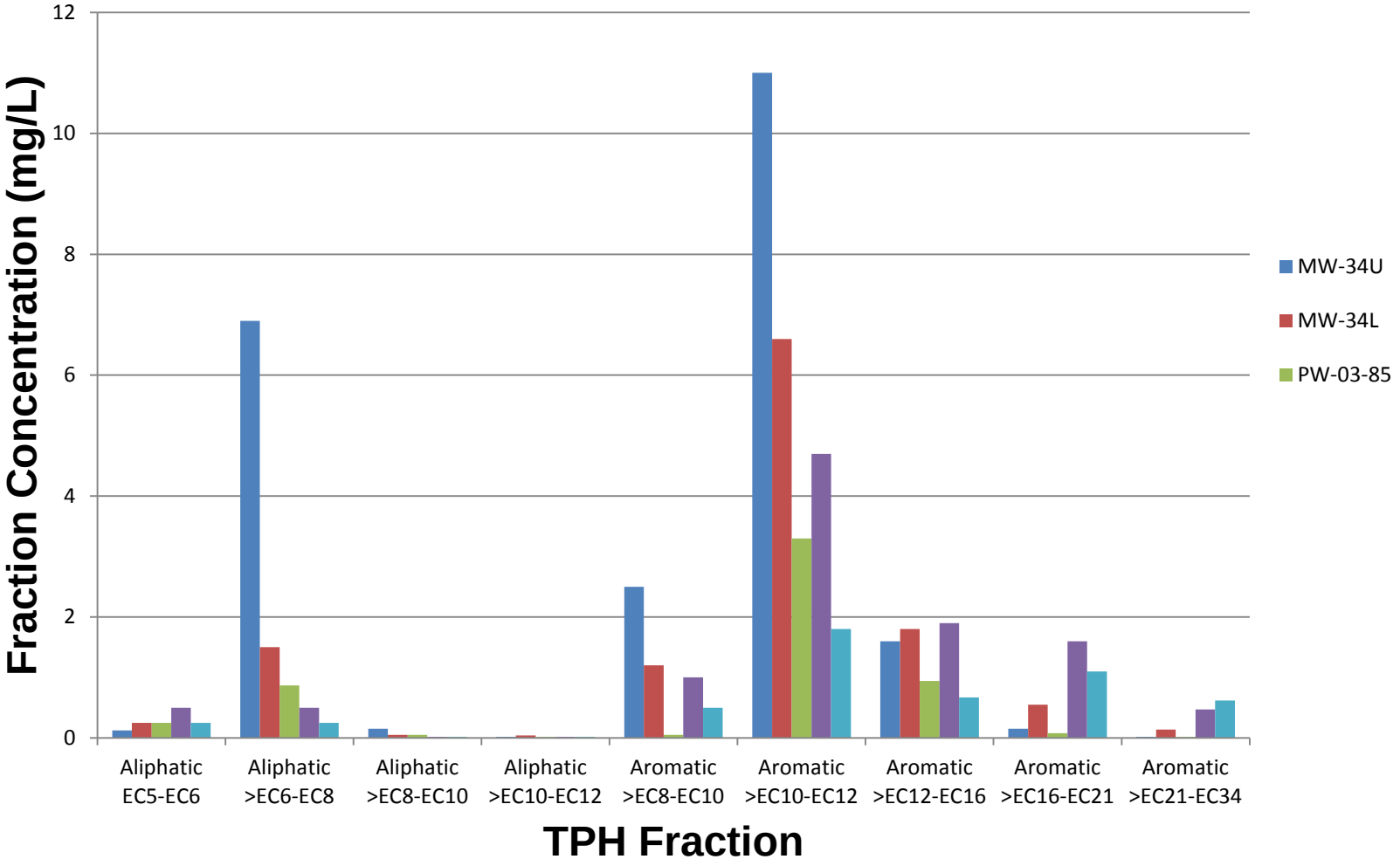
- The TPH fractions discussed in this memo are part of the standard analyte list for the VPH and EPH methods, and thus will be reported out whether the PRGs for the various fractions are adopted. Not including all of the fractions could result in compliance issues and concerns that remedies are not adequately protective.

Table 1
Summary of October 2014 TPH Fraction Groundwater Data at Gasco Site
Surficial and Upper Alluvium Water-Bearing Zones Near Riverbank

TPH Fraction	Screening Value (ug/L)	Maximum GW Concentration (ug/L)	Maximum Hazard Quotient
Aliphatic			
EC_5 - EC_6	121	Mostly ND (50)	NA
$EC_{>6}$ - EC_8	54	6,900	128
$EC_{>8}$ - EC_{10}	9.6	150	16
$EC_{>10}$ - EC_{12}	2.6	ND (50)	NA (19)
$EC_{>12}$ - EC_{16}	NA	ND (40)	NA
$EC_{>16}$ - EC_{21}	NA	ND (40)	NA
$EC_{>21}$ - EC_{34}	NA	ND (40)	NA
Aromatic			
$EC_{>8}$ - EC_{10}	240	2,500	10
$EC_{>10}$ - EC_{12}	79	11,000	139
$EC_{>12}$ - EC_{16}	20	2,000	100
$EC_{>16}$ - EC_{21}	4	1,600	400
$EC_{>21}$ - EC_{34}	15	620	41

Notes:
Screening values based on narcosis endpoint, calculated using lowest observed effect residue of 0.24 mmol/kg, and chemical-specific Koc, Kow, and BCF values.
EC = Equivalent carbon
ND = Non-detect (detection limit)
NA = Not applicable (calculated hazard quotient at detection limit)

Figure 1: Water Concentration of TPH Fractions in Selected Gasco Riverbank Monitoring Wells



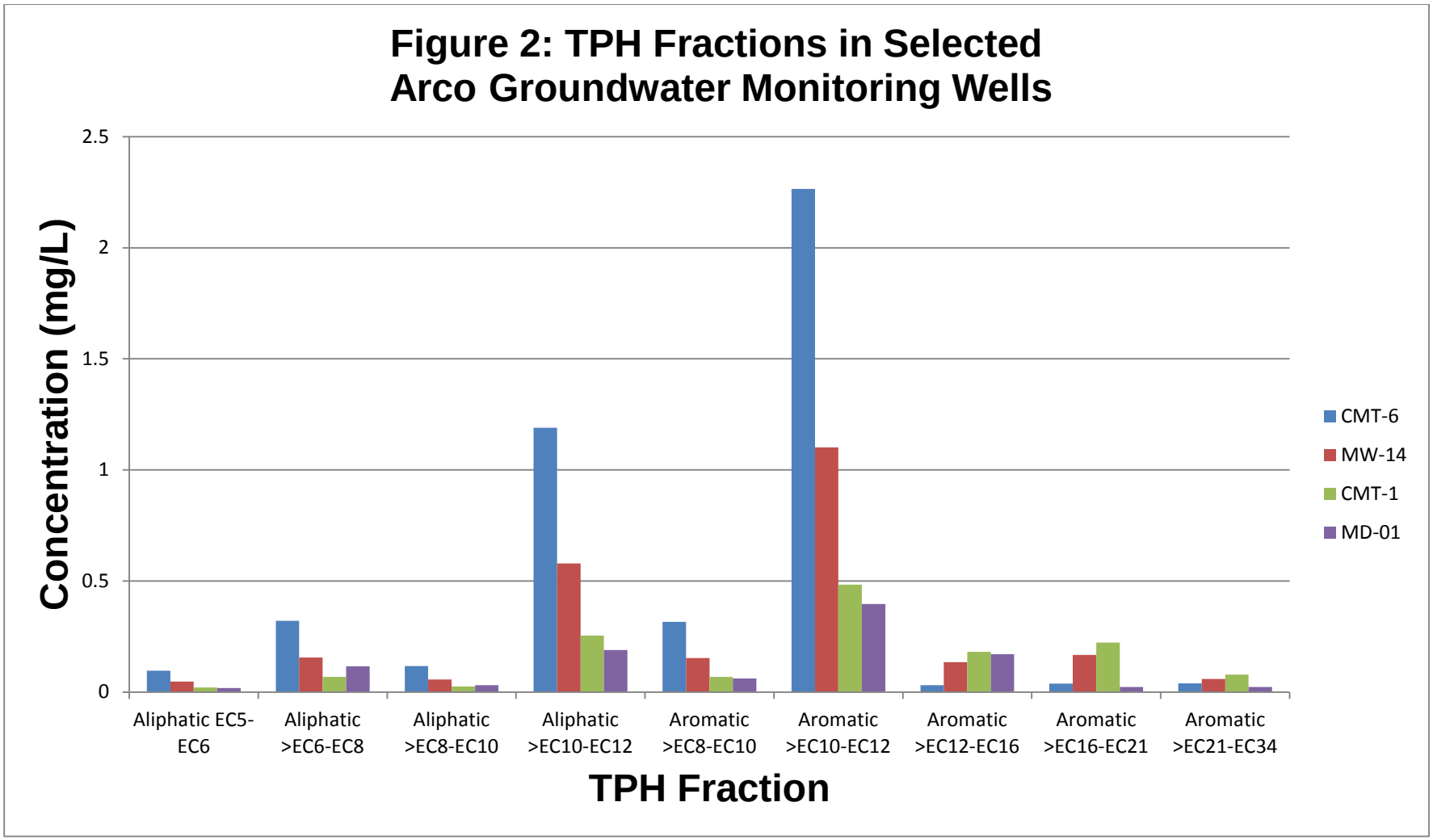


Figure 2: TPH Fractions in Selected Arco Groundwater Monitoring Wells
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Aliphatic EC5-EC6
Aliphatic >EC6-EC8
Aliphatic >EC8-EC10
Aliphatic >EC10-EC12
Aromatic >EC8-EC10
Aromatic >EC10-EC12
Aromatic >EC12-EC16
Aromatic >EC16-EC21
Aromatic >EC21-EC34
TPH Fraction
CMT-6
MW-14
CMT-1
MD-01

Figure 3: TPH Fraction Hazard Quotients in Selected Gasco Riverbank Monitoring Wells

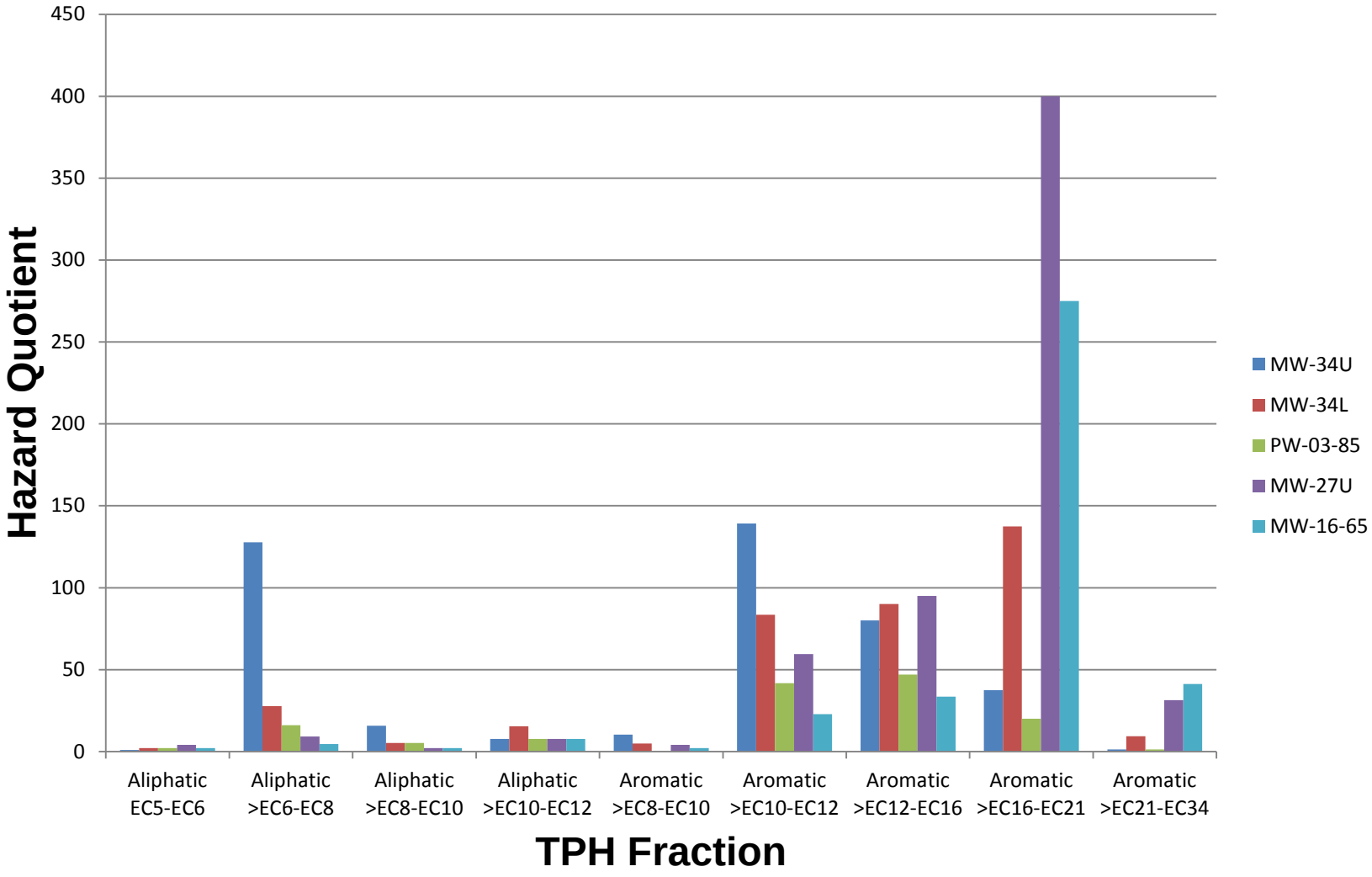


Figure 4: Hazard Indices in Selected Gasco Riverbank Groundwater Monitoring Wells

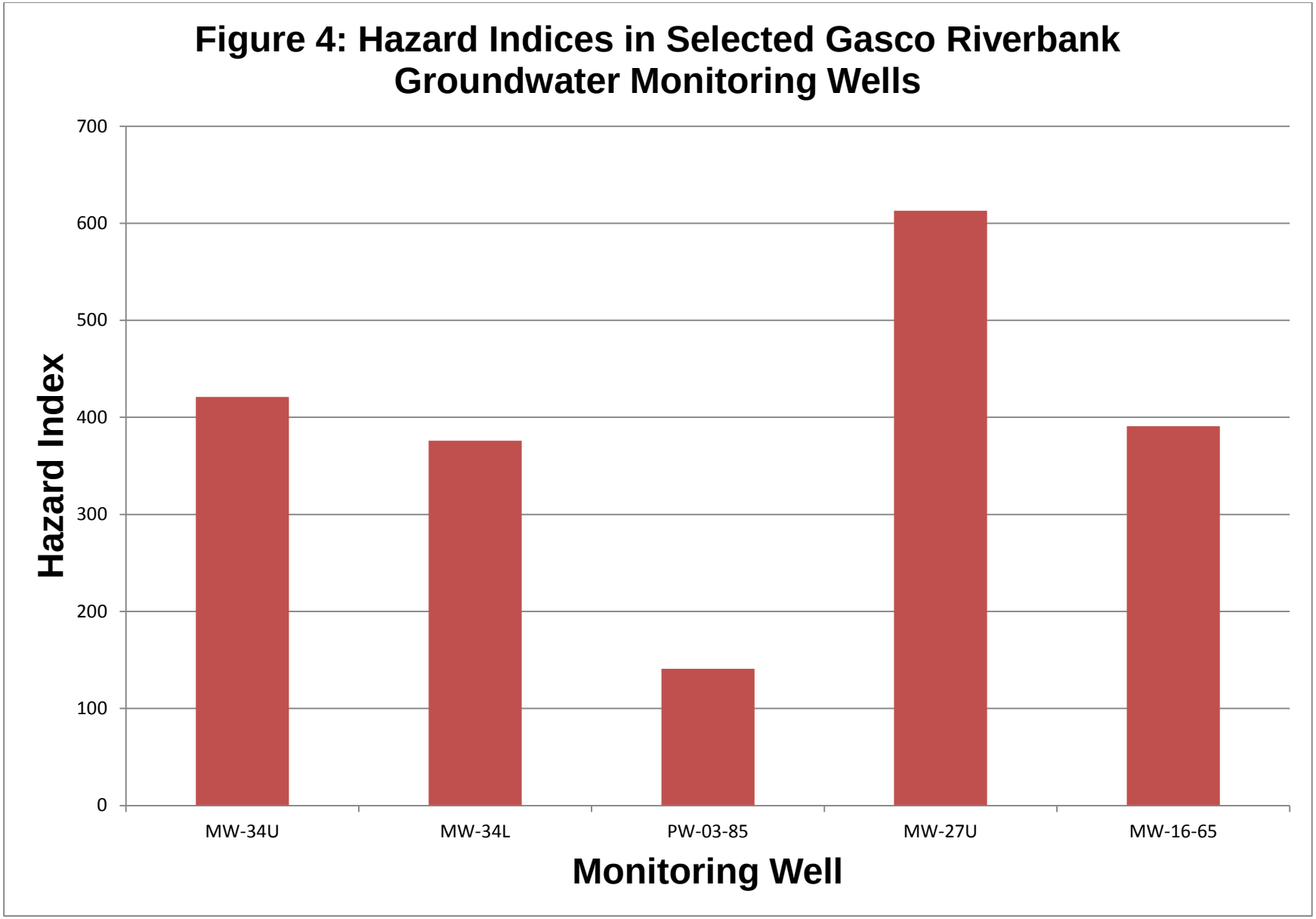
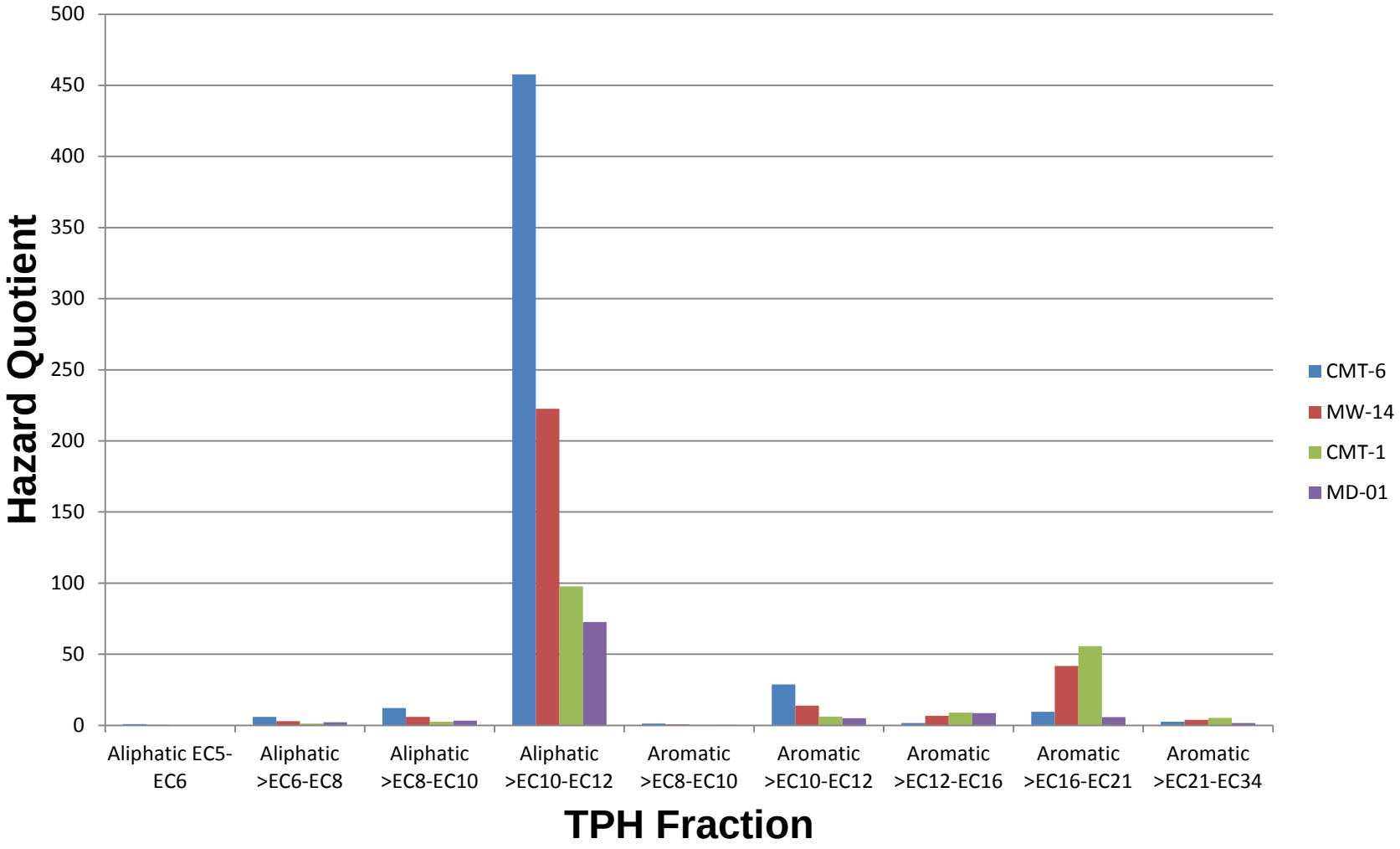


Figure 5: TPH Fraction Hazard Quotients in Selected Arco Groundwater Monitoring Wells, March 2012



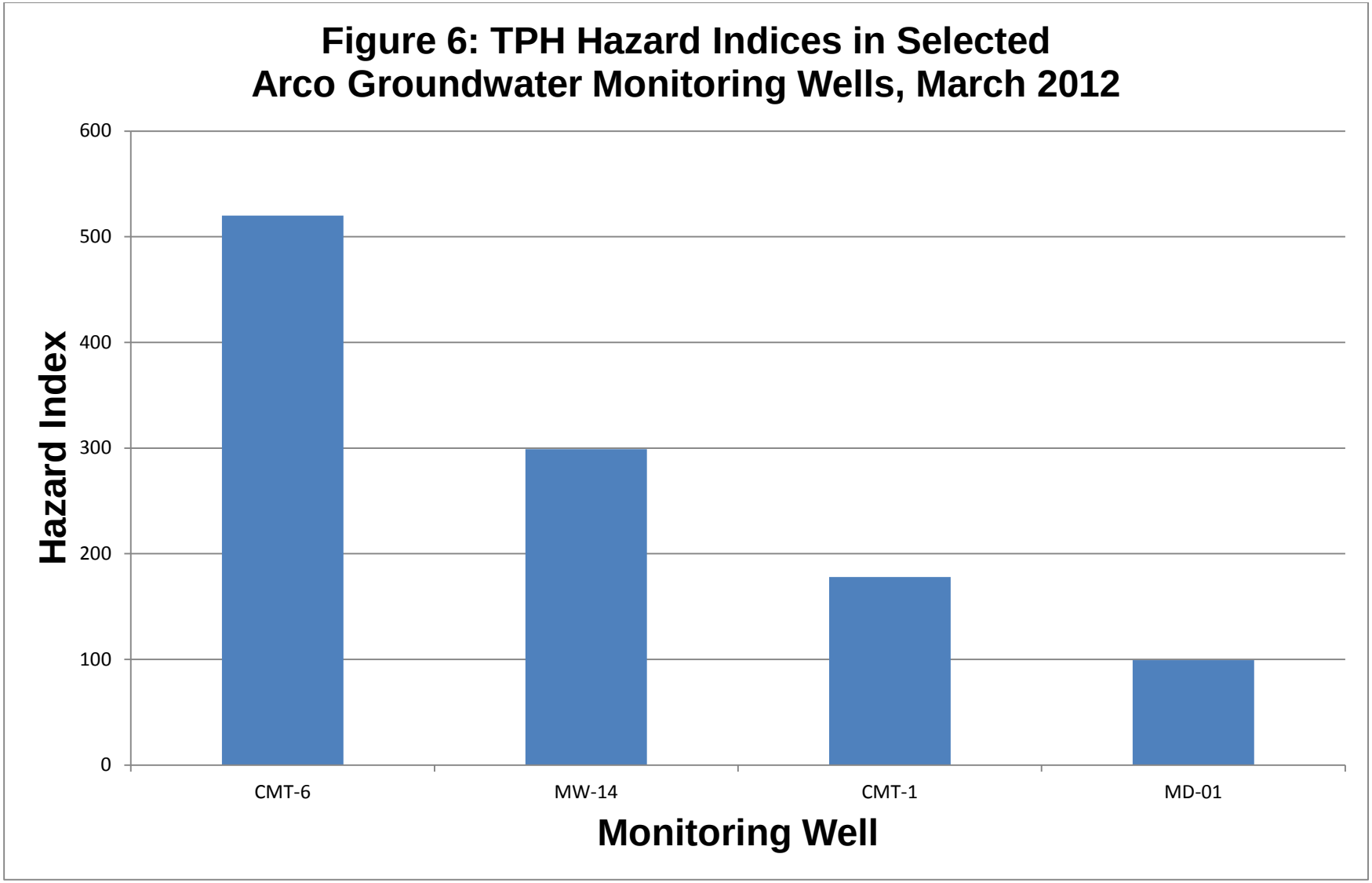


Figure 6: TPH Hazard Indices in Selected
Arco Groundwater Monitoring Wells, March 2012
Hazard Index
600
500
400
300
200
100
0
CMT-6
MW-14
CMT-1
MD-01
Monitoring Well